U. S. Fisheries Biological Station,
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ALASKA AGRICULTURAL EXPERIMENT STATIONS
SITKA, ALASKA
Under the supervision of the
UNITED STATES DEPARTMENT OF AGRICULTURE

BULLETIN No. 6

CEREAL GROWING IN ALASKA

BY

C. C. GEORGESON, Director
and
G. W. GASSER, Agronomist
Assistant in Charge, Fairbanks Station

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ALASKA AGRICULTURAL EXPERIMENT STATIONS, SITKA, KODIAK, RAMPART, FAIRBANKS, AND MATANUSKA

[Under the supervision of the Office of Experiment Stations, United States Department of Agriculture]

E. W. ALLEN, *Chief, Office of Experiment Stations.*

WALTER H. EVANS, *Chief, Division of Insular Stations, Office of Experiment Stations.*

STATION STAFF

C. C. GEORGESON, *Director.*
G. W. GASSER, *Assistant in Charge, Fairbanks.*
W. T. WHITE, *Assistant in Charge, Kodiak.*
M. D. SNODGRASS, *Assistant in Charge, Matanuska.*
E. M. FLOYD, *Assistant in Charge, Rampart.*
HANS LINDBERG, *Horticulturist, Sitka.*
J. C. WINGFIELD, *Assistant Horticulturist, Matanuska.*
H. O. WHITE, *Assistant, Kodiak.*

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Prior to the establishment of the Alaska Agricultural Experiment Stations it was almost universally believed that Alaska was a frozen, inhospitable wilderness, and therefore worthless for agricultural purposes. Even as late as 1899 it was declared wholly unreasonable to expect anything like cereals to grow so far north, this statement being fortified by an account of the glaciers and ice fields that the tourist sees in the coast region. To-day, however, public opinion is favorably changing as the result of experiments carried on by the stations; and it is beginning to be realized that the country has great agricultural possibilities, its productive power being merely a matter of development. (Fig. 1.)

BRIEF HISTORY OF THE WORK WITH CEREALS

The cereal work of the stations has been developed from small beginnings. When the first agricultural experiment station in Alaska was established in April, 1898, at Sitka, then the capital and the best-known settlement, it was known that hardy vegetables could be grown in favorable places in the coast region, but no attempts had been made to grow grains, chiefly because of a rooted conviction that they could not be grown. Experiments with spring wheat, barley, oats, and winter rye were therefore begun on the station grounds and on some small garden patches which were placed at the disposal of the station. The crops matured during the favorable summers of 1899 and 1900, and samples of the grain were sent to Washington, D. C. Some varieties of barley and oats, seeded at Skagway in 1898,

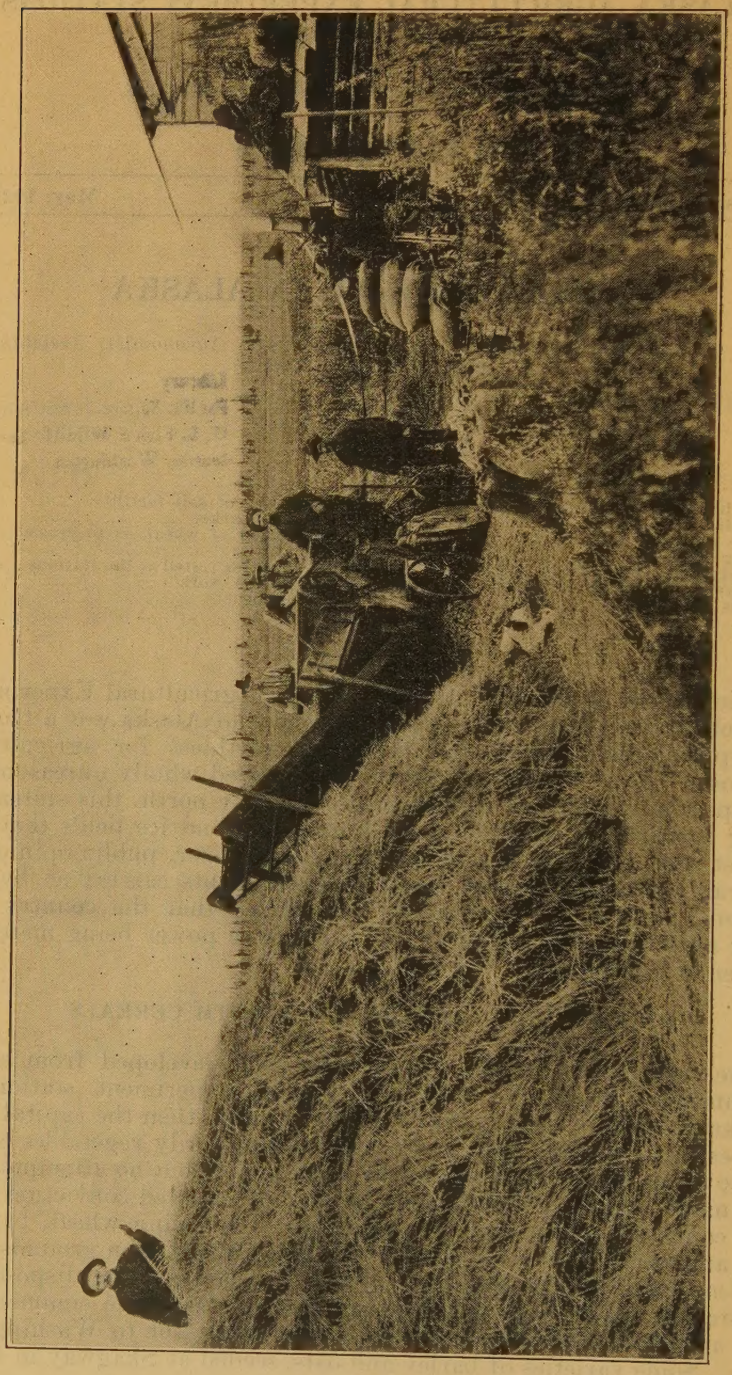

FIG. 1.—Threshing grain in Tanana Valley

also matured. However, the summers of 1899 and 1900 were more favorable for cereals than is the average summer in the coast region. In following years it was found that the usual heavy rainfalls from August until early frost either prevented the crops from maturing or made it impossible to save the grain after the crops did mature. Grain growing apparently can not be made an economic success in the coast region for this reason and also because there are no extensive areas that can be cleared and cultivated at a moderate cost.

Half an acre was cleared at Rampart in the summer of 1900 and seeded the following spring to several varieties of barley, oats, and spring wheat, all of which matured. Several varieties of oats, barley, and spring wheat were seeded at Kenai, on Cook Inlet, in 1900, but only a small percentage of the grain matured because of the cool summer. The work was continued long enough to prove that cereal raising could not be made a success in this region, at least not until there were developed varieties that would mature in the comparatively cool summers. Kenai is, however, well adapted to grain growing for hay and silage.

In 1902 tests were begun in the Copper River Valley, near the settlement of Copper Center, with the earliest maturing varieties of barley, oats, and spring wheat that could be found. The earliest of these matured, at least in part, every year, but the later varieties never matured. A killing frost invariably occurred about the middle of August, and all grains that had not matured then had to be cut for hay. The results proved that the rainfall was too light to produce a normal grain crop, the total precipitation, including melted snow, averaging about 9.5 inches a year. A list of the grains which were grown during the six years of the existence of the stations is given on page 23. In 1907 cereal investigations on small areas were begun in the Tanana Valley, 6 miles from Fairbanks, and in 1916, when the Government railroad was completed, a tract of 240 acres in the Matanuska Valley was selected as the site of an experiment station. Clearing and building were begun in 1917. There are now 80 acres under cultivation.

CLIMATE AND SOIL

Climate and soil play an especially important part in cereal production in Alaska.

CLIMATE

Alaska has two climatic belts—that of the coast region and that of the interior. Meteorologists differentiate still a third—the arctic belt—which, however, does not concern farmers at present.

The coast region is the narrow belt lying between the ocean and the Coast Range Mountains, including the islands. The climate is characterized by cool summers, heavy rains, clouded skies, and comparatively mild winters. The region is mountainous and heavily timbered and has no extensive areas suited to farming. There are, however, numerous small tracts of land about bays and inlets which can be farmed on a small scale, but climatic conditions do not favor grain growing. In favorable seasons grain can be matured, as, for instance, happened at the Sitka station in 1899 and 1900 when there was an unusual amount of sunshine and comparatively little rain. The climate is well suited to livestock raising.

The region generally referred to as the interior is the immense area lying north of the Coast Range Mountains, and embraces the great valleys of Alaska proper, more particularly the Yukon, Tanana, Matanuska, and Susitna Valleys. The climate differs in a most striking manner from that of the coast region. The moisture coming from the ocean is chilled in passing over the mountains and is therefore deposited on the west or south slopes. As a result, the winds carry to the whole interior region only a light rainfall which varies according to local physiographic features. As compared with the coast region, the interior has warm summers, very cold winters, no beating storms, and a greater percentage of sunshine. Under such conditions, cereals that are early enough to develop fully in the short period between frosts can be matured. The annual precipitation, including melted snow, varies from 9 to 16 inches, an amount that would be sufficient for grain growing were the rain so distributed that a due proportion would fall during the growing season. This, however, is not always the case. Protracted dry spells, which reduce the production of grain, are likely to occur in May and June and even in July. The quality of the crop may be excellent, but the straw will be short and the heads small. Again, the frost-free period—that is, the time between the last frost in spring and the first frost in fall—varies widely with the latitude and the local conformation of the country. At Rampart in the Yukon Valley, and at Fairbanks in the Tanana Valley, the period averages a little short of 100 days. Some years it is less than 100 and at times it exceeds 100 days.

Table 1 shows the length of the frost-free period during the 13-year period 1908–1920, at Fairbanks, and during the 15-year period 1906–1920, at Rampart, together with the precipitation for the five growing months of May, June, July, August, and September.

TABLE 1.—*Frost-free period and summer precipitation at the Fairbanks and Rampart stations*

Year	Frost-free period		Precipitation for growing season		Year	Frost-free period		Precipitation for growing season	
	Fairbanks	Rampart	Fairbanks	Rampart		Fairbanks	Rampart	Fairbanks	Rampart
	Days	*Days*	*Inches*	*Inches*		*Days*	*Days*	*Inches*	*Inches*
1906	----------	96	----------	5.40	1915	109	107	9.95	6.78
1907	----------	107	----------	10.27	1916	90	89	9.56	5.59
1908	111	99	4.45	5.35	1917	122	117	7.31	6.81
1909	103	90	6.09	5.67	1918	56	94	5.74	3.70
1910	90	84	6.61	2.94	1919	112	93	8.30	7.18
1911	106	107	6.06	3.16	1920	88	87	4.98	3.83
1912	107	110	7.31	7.45					
1913	82	89	7.37	5.06	Total	1,259	1,454	93.88	83.74
1914	83	85	10.15	4.55	Average	96.9	96.9	7.22	5.58

The average frost-free period for the six-year period 1917–1922 was 69 days at Nome, 104 at Nenana, 77 at Tanana, 103 at Anchorage, 87 at Chitina, 127 at Seward, 156 at Juneau, and 157 at Sitka.

Grain is not injured either by a drop in temperature of 1° or 2° below 32° F. for a few hours, or by a light frost, unless possibly

when in the flowering stage. The period during which it is safe from injury by frost is therefore longer than is the frost-free period as here recorded. Owing to uncertainty as to the length of this period it is important that only early-maturing grains be grown. Varieties requiring a longer period than 100 days are often killed by early fall frosts. Usually seeding can begin the first part of May in the Yukon and Tanana Valleys, where killing frosts seldom occur before the last of August or the first of September.[1] Often there is a period of warm, sunny weather following the first frost, and during this time the grain fully matures.

SOIL

As is to be expected, Alaska has a great variety of soils. In the coast region there are extensive areas of peat, formed chiefly from sphagnum mosses. These are unsuited to grain growing. In well-drained areas the soils are clayey, sandy, and gravelly in character, with the gravelly type predominating. These must be fertilized to maintain their productivity. Sandy and gravelly soils, usually denominated warm soils because they absorb heat readily, have an advantage over other soils in that crops growing on them develop early and mature before frost. Silt soil, which is very fertile, occurs in some well-drained areas.

Interior soils.—The river valleys, which constitute the farming sections, embrace a number of soils. Excellent silt loams are found over large sections, as, for instance, in the Tanana and Matanuska Valleys; but as a whole gravelly soils predominate in the interior. Nowhere are there to be found such rich prairie soils as are peculiar to certain extensive sections of the States. It should be borne in mind that the soils of Alaska are new, the ice cap which once covered the continent as far south as Ohio remaining in these northern latitudes long after it had disappeared from the more southern latitudes. The glaciers still existing in Alaska are probably remnants of the ice cap, and the soil has been formed by attrition of rock particles, the movement of water, and the accumulation of vegetable matter. Vegetation could not cover the land until the ice melted, and even then the accumulation of vegetable matter and the formation of soil would proceed slowly.

Soils at the stations.—No two of the Alaska stations have similar soils. At Sitka, where vegetation has been luxuriant for perhaps thousands of years, the surface soil is mostly humus and partly peat. Similar soil is not found in the interior. At Rampart the soil is a clay loam which, though somewhat hard to cultivate, is well adapted to grain. At Fairbanks the soil varies with the contour of the surface. The best type of soil is the Tanana Valley silt, which predominates on slightly rolling upland and is underlain by clay. At Kenai, where grain growing was tried unsuccessfully for a few years, the soil is gravel, mixed with a large percentage of vegetable mold. At Copper Center the soil is thin and gravelly, being underlain with gravel. It lies in benches, each of which is comparatively level and drains readily. In the Matanuska Valley the prevailing soil is comparable with the predominant type of soil found in the Tanana Val-

[1] Detailed climatic data for upward of 30 places are given in the annual reports of the stations, available copies of which may be had upon application to the Sitka station.

ley and is fertile and productive. So far as it is known, the Tanana and the Matanuska Valleys have the best soils in the interior for grain growing and for general farming.

CLEARING LAND

The problem of clearing land at the least expense must be solved by every homesteader and new settler in Alaska. With the exception of the lowlands along streams and tide flats which are overflowed, the coast region is heavily timbered, largely with spruce. In these areas clearing for farming purposes is laborious and at present prices well-nigh prohibitive.

In the interior, where clearing can be done more economically, grain growing is likely to be a leading industry. Clearing should be done during the comparatively warm and dry months of May and June. The simplest method is to fire the moss and undergrowth and keep it burning by constant attention. If possible, burning should be started when the wind is from a direction that will send the fire through the purposed clearing. Every precaution should be taken against its spreading beyond the area intended, however. The lowlands are timbered with small black spruce trees which are so dense in places as to make it almost impossible to go between them. On the highlands the prevailing timber is birch, interspersed with cottonwood. In both cases the timber should be slashed some months or even a year before burning begins. When the timber is slashed and thrown into windrows it will usually dry out sufficiently to burn readily the following summer. Moss and undergrowth which have thoroughly dried out usually burn so completely as to leave the roots bare of support.

Occasionally there are found in the interior areas that have been partly cleared by accidental fires. The moss, small vegetation, and mold which supported the shallow-root system of the spruce trees have been consumed by the fire and the dead trees have been tossed in all directions by the wind. Such tracts as these were found at the station reservations at Copper Center, Fairbanks, and Matanuska. A strong, experienced man should be able to pile and burn several acres of the charred poles in a short time and finish the work with a systematic burning. After the few stumps remaining have been removed and the ashes scattered the land will be ready for the plow. Conditions similar to these must be created where old burns are not available. The green timber should be slashed and the trees thrown in one direction. The brush will be dry enough to burn the following spring, and charred or partly burned trunks can be salvaged for posts or firewood. The stumps still remaining in the ground should be removed with a stump puller. At the Kenai station a simple, inexpensive stump puller consisting of two triple pulleys and 300 feet of 1½-inch rope was used to clear the ground. The small spruce trees of the interior seldom exceed 4 to 6 inches in diameter.

Usually some power is required to remove birch stumps from the hillsides and higher lands. These stumps may rot sufficiently in two or three years to be knocked out readily with hand tools; or, if the work must be done at once, they can be removed by means of a tackle of the type mentioned above, or by a small stump-puller, which has

a steel cable instead of a rope and is operated by one horse on a sweep. (Fig. 2.) Picric acid has been used with satisfactory results as an explosive in removing stumps in the Matanuska Valley, where the timber is somewhat larger than it is in either the Tanana or Yukon Valleys. The expense of clearing green timber is three times as great as for burned timber, and for this reason the stations do not recommend the clearing of the former. It is better to slash the timber and let it lie for a year, and when the trees have dried and the wind is right, burn it before attempting to pull the stumps. When work was begun at the Matanuska station and there was urgent need for land, a small tract of green timber was contracted to be

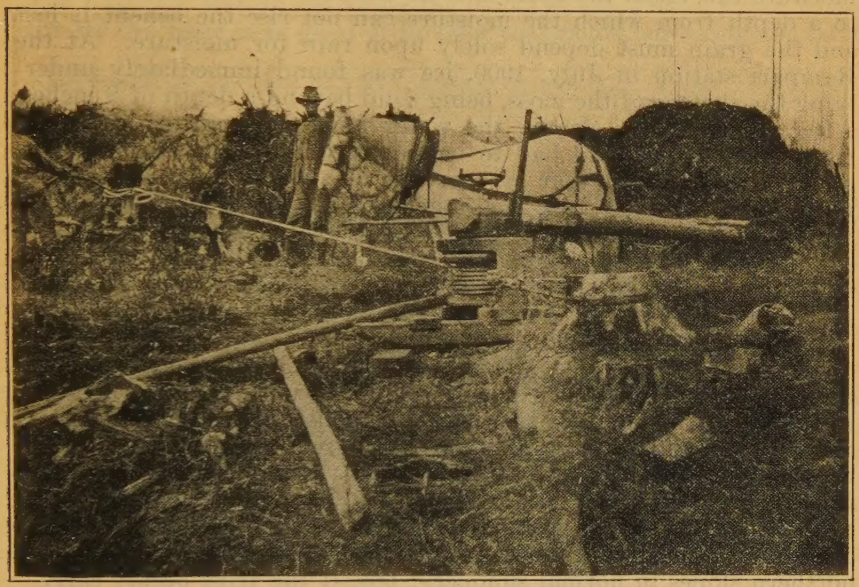

FIG. 2.—Stump puller at work, Rampart station

cleared at $125 per acre. After a few days, however, the contractor gave up the job. Similar areas, after being slashed and burned, have been cleared since at $30 per acre.

CULTURAL CONDITIONS

Surface drainage.—In the interior comparatively little land is so wet as to require underdrainage, but nearly every settler finds it a problem to protect his farm from surface washing during the spring thaws. At this time the snow water rushes from the hillsides across cultivated fields and graded roads, carrying off the soil and making deep gullies as it goes and necessitating much labor in filling. On the more level lands the water is likely to stand for several days, alternately freezing and thawing and killing all half-submerged plants. The fields should be watched during the thaw and provided with ditches to carry off the water. This problem had to be met at both the Fairbanks and the Rampart stations.

Ice in the ground.—In the latitudes of Rampart and Fairbanks the uncleared ground is frozen to an indefinite depth, often to bedrock, 50 to 100 feet below the surface. There are areas here and there, especially on southern slopes, which are not frozen beyond the depth that is reached by frost each winter. Such areas are referred to as thawed ground.

Ground ice has been found to be of decided advantage for grain growing in the interior. When the ground is cleared sufficiently to expose the surface to the sun, the underlying stratum of ice gradually thaws and by capillary action furnishes moisture to the roots of grain, thus serving as a system of subirrigation. As long as this moisture can reach the roots it is of benefit, but once the ice thaws to a depth from which the moisture can not rise the benefit is lost and the grain must depend solely upon rain for moisture. At the Rampart station in July, 1900, ice was found immediately underlying the surface of the moss, being solid beyond a depth of 8 inches. After the land was cleared the water from the melting ice would rise to the surface and had to be led off before anything could be planted. Gradually, year by year, the ice receded, and six or seven years later it was 5 feet from the surface. Moss and vegetation protect the ice in much the same way that sawdust does in a cold-storage plant. At the Fairbanks station the ground ice thaws more readily in certain spots on north-slope fields than it does as a whole. As a result the soil settles in these spots and forms hollows which interfere with cultivation.

Southern exposure.—The settler who would get good crops and early returns for his labor should begin clearing on southern slopes, if such land is available. It has been demonstrated both at Rampart and at Fairbanks that grain crops will grow more vigorously and reach maturity earlier on southern slopes than on northern or other slopes, or even on level land. The added warmth and light received by the southern slopes stimulate growth. Early-maturing varieties of grain ordinarily produce a crop before the first frost even on northern slopes in normal summers; but, if the frost occurs early—say about August 20—grain on a northern slope may be damaged, while that on a southern slope will be almost certain to escape injury. Some 6 miles from Fairbanks there is a semicircle of hills which were originally covered with a fine birch forest. Many of the homesteaders, who realize that birch occurs almost exclusively in soil of excellent quality, are growing most of their fine grain crops and potatoes on these hillsides. The homesteader who understands the quality of birch land will therefore select his homestead on such land if possible. The largest birch timber is always found on rich silt loams, whereas the spruce peculiar to much of the interior is often found in thin gravelly soils. The south slope was of advantage even in the original forest, producing larger birch trees than did the northern slope. However, southern slopes have their disadvantage as well as advantage. In after years, when the underground ice has receded considerably, southern-slope lands will be found to suffer more from drought during dry spells than will level or northern-slope land.

Frost.—It is a well-known fact that cold air is heavier than warm air and that it settles in low places on cold nights. A slight eleva-

tion of perhaps only 25 to 50 feet will often escape early frost while level land lying at the base will suffer. Grain crops and other tender crops, especially potatoes, should therefore be planted on slight elevations rather than on bottom lands. This fact has been demonstrated repeatedly at the Rampart and the Fairbanks stations. Nevertheless, some homesteaders, who reason from their experience in the States, clear the bottom lands first, believing that the soil is richer and therefore likely to make better yields than on the hillsides. This may or may not be true, but it is certain that crops on bottom lands, unless they are along a stream where the air drainage is good, will suffer from light frosts earlier than crops on an elevation of, say, 50 to 75 feet. There are, of course, some exceptional cases. The Rampart station lies along the banks of the Yukon River where the air drainage is so good ordinarily that fields bordering the bank

FIG. 3.—Siberian No. 1 wheat, Matanuska station. Frost injured, but showed 85 per cent germination

do not suffer from frost any earlier than do the more elevated sections of the station.

Small grains are not sensitive to light frosts. A frost which is so severe as to kill potato tops may not harm grain crops provided they are in the dough stage or beyond it. This was illustrated at the Matanuska station in 1922, where a frost occurred August 22. Only the earliest varieties of grain were ripe and past danger from frost. A field of spring wheat had scarcely begun to turn. It was expected that the grain would be killed. The crop suffered some damage, but fully 85 per cent of the grain germinated, notwithstanding the fact that it had been frosted and was not fully ripe at the time of harvest. (Fig. 3.) Frosts occurring late in August often damage immature grains, but much of the grain may mature and can be used for seed. Light frosts in August are usually followed by days of warm sunshine, during which the grain fully matures.

Fall rains.—It sometimes happens that frosts are held off during the first half of September by a period of cloudy, rainy weather, and the fields in consequence remain green long after the normal time of harvesting. Usually the grain has fully developed by this time, but has not acquired the hardness of ripe grain. In such cases it may be advisable to harvest the crop and stack the grain on pole racks or so-called swedes to dry. (Fig. 4.)

Climatic differences due to latitude.—The Matanuska station, which lies in latitude 61° 30′, is 3° south of the Fairbanks station. Because of its earlier spring and later fall frosts the more southerly station has a decided advantage over the northerly one; that is to say, it has a growing period of 115 to 120 days, or 17 to 22 days more than Fairbanks has. A killing frost may occur at Fairbanks in August, at which time the temperature may not fall to freezing

FIG. 4.—Construction of stack rack for curing green or wet hay, Fairbanks station

at Matanuska. On the other hand, grain grows more rapidly and reaches maturity in a shorter period under normal conditions in the northern latitudes than it does farther south. The Rampart station lies in latitude 65° 30′. The same varieties of grain mature about the same time at Rampart and at Fairbanks, somewhat farther south, and at Matanuska; that is to say, because of the influence of a longer period of daylight during the growing season—June and July—the crops mature in a shorter time than they do at Matanuska, 3° and 4° farther south. This was one of the principal reasons for continuing the grain-breeding experiments at Rampart. It was inferred, and rightly, that grain which would grow within a few degrees of the Arctic Circle would be early enough to mature in all latitudes south of Rampart. It is known that early maturing barleys will ripen as far north as latitude 68°. In 1906 ripe barley was found growing in a garden at Coldfoot, in latitude 67° 30′.

AREAS AVAILABLE FOR GRAIN GROWING

The areas which are known to be adapted to grain growing at present embrace the Tanana, Matanuska, and Yukon Valleys. The building of the railroad from Seward to Fairbanks has made these areas readily accessible to settlers. Other sections of Alaska are undoubtedly equally well adapted to grain growing, although this fact has not yet been proved by actual experiment. It has been estimated that there are 750,000 acres of good land which can be made available for agriculture in the valley of the Tanana and its many tributaries. The area is covered with a wealth of grass and in places with birch timber, which indicate productive soil. On the west bank of the Susitna River there is an extensive tract of birch timber, the agricultural area of which, although not as yet determined, could, it is thought, be adapted to grain growing. Reports from the Kuskokwim Valley indicate that grain can be successfully grown there as soon as the region becomes accessible.

METHODS OF CULTURE

Although methods of culture in Alaska do not differ materially from those followed elsewhere, there are a few points, such as fall plowing, early seeding, and the selection of early-maturing varieties, which need to be emphasized in connection with grain cultivation in these far northern latitudes.

Fall plowing.—Experiments at the stations indicate that fall plowing is necessary for the best results in grain growing. Fall plowing to a depth of 6 or 7 inches makes the soil sufficiently porous to absorb and hold moisture accumulating in the fall before frost, as well as the water resulting from melting snows in the spring. This reservoir of moisture may be sufficient to carry the growing crop through the period of drought which often occurs in May and June and even in July. Deep plowing also increases the amount of soil from which the plant food can be drawn and exposes a greater volume of earth to atmospheric action than does shallow plowing. Though it is true that grains do best in a firm soil, it is also true that the period between plowing in September and seeding in May is sufficiently long to permit of the soil settling into a firm bed. Fall plowing places the soil in the best condition in the shortest possible time and with the least amount of work for seeding in the spring when time is at a premium. The furrow should be left rough. It is a mistake to use the harrow in the fall. A rough surface is better able to hold the snow, if there is necessity for holding it, than is a smooth surface. Spring plowing for grain growing should be avoided. If it has not been possible to plow in the fall before the freeze-up, it will be a mistake to plow in the spring. In such a case the surface should be thoroughly disked and seeded. Every effort should be made to fall plow before frost, even if extra teams or a tractor plow must be called in to rush the work.

Early seeding.—Seeding should begin on high land, preferably with a southern exposure, as soon as the snow has disappeared from the knolls and ridges. The surface should be leveled with a smoothing harrow and, if the soil is loose, gone over with a grain drill

followed by a packer. A drill is better than broadcasting for putting in the seed, because it distributes the seed evenly and lays it at a uniform depth. In broadcasting, much of the seed is likely to remain exposed on the surface and another considerable percentage may be barely covered, resulting in a shallow-rooted crop which will suffer much during the period of drought. The grain should lie 1½ to 2 inches below the surface level, in loose soil 3 inches deep. Early seeding is very essential. Ordinarily, seeding begins about the middle of May at the Rampart and Fairbanks stations. In some instances it has begun as early as May 4; but normally the snow does not disappear nor does the surface dry sufficiently to work before May 15 or May 20. Spring wheat which is intended for milling, and barley and oats for seed, should be in the ground by May 25. Condition of the soil permitting, it is better to rush seeding by employing extra help than it is to allow it to drag along until June. Seeded after June 1, the grain is likely to be caught by early

FIG. 5.—Oats grown on new land for hay

fall frosts and must be cut for hay. Varieties from which seed is desired should be sown first. Those intended for hay can be sown as late as June 10 and still produce an excellent crop. Good judgment should be exercised in the selection of locations for grains. Grain crops should, as far as possible, be grown on south-slope lands, else they may fail to mature before heavy fall frosts. Hay grain, on the other hand, can be grown on north-slope lands.

Cropping newly cleared land.—Unless the surface layer of moss is completely burned off and the ashes are evenly distributed, the first crop on newly cleared land is likely to be spotted and to mature irregularly. Newly cleared land should be seeded to a hay crop the first time. In some instances a satisfactory grain crop may be produced the first year on well-prepared land, but experience at the stations shows it advisable to start with a hay crop. New land is usually the last to dry sufficiently to be put in condition for seeding. It is therefore suitable for hay crops which can be seeded late and will often produce a heavy yield. (Figs. 5 and 6.)

Use of the tractor.—The farm tractor of the smaller type is a profitable investment for interior Alaska farms, especially for grain growing. The initial expense is possibly a little more than that of a team of horses, but when the cost of transporting horses from Puget Sound to Alaska and the quantity of feed consumed en route are considered, the tractor will be found the more economical of the two sources of power. The stations operate four tractors and find them cheaper to maintain than teams. A good tractor can be bought for about $500. A large, well-matched, young team will cost nearly as much. The team, however, must be fed the year round; the tractor does not eat up its value in feed when not in use and it is always on hand when needed. It costs about $200 a year to maintain a horse in Alaska, exclusive of the labor required to care for it. The gasoline, or kerosene, and lubricating oil which are consumed

FIG. 6.—Crop of oats grown on new land for hay; 2¼ tons per acre

by a tractor during the working season will hardly exceed $150. There may be places where a team can be worked to better advantage than a tractor, but this fact does not compensate for the greater power furnished by the latter. A tractor will work a larger area in a given time than a team can, which is an important advantage where seeding and harvesting must be done quickly. (Figs. 7 and 8.) In addition, a tractor can be used to furnish power for threshing and for wood sawing, as well as for hauling heavy loads on level ground.

Selecting seed grain.—Grain for seed should be sown on the earliest land available, so as to mature thoroughly before harvest time. When the season is unfavorable or suitable land can not be had, the grower should take every precaution to reserve seed in case of failure the year following, gathering it, if necessary, from patches here and there producing earlier and more mature grain than is

found in the average run of the field. Selections at the stations have been made from small patches that were especially promising and early enough to give a 100 per cent viability. Owing to the large number of varieties under test at the stations, the plats are gone over daily during the period of ripening and the earliest and best heads are selected for seeding the following spring. These are laid away until they can be individually and critically examined, when a final selection is made. In many of the tests, including sometimes hundreds of different kinds of grain, only one to six rows of each kind and often only the grain from a single head, are grown on a plat. There is therefore a small crop to choose from, and the bundles are small. In general farming as large an amount as possible of selected, large, early heads should be collected before harvest and the grain sown on a favorably situated plat for perpetuating particular varieties. In Alaska, more than in southerly regions, it is

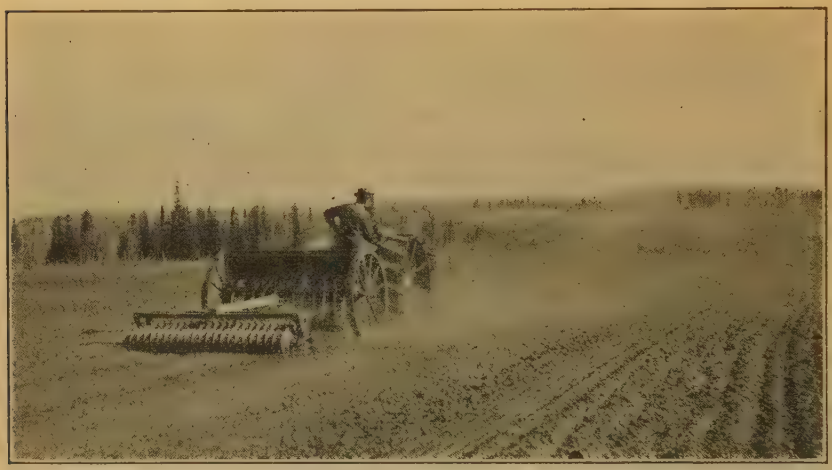

FIG. 7.—Grain drill and packer in tandem, drawn by tractor, Fairbanks station

desirable for each farmer to grow as much of his own seed grain as possible. It has been repeatedly demonstrated that selected seed will give a better yield than seed coming from the ordinary run of crop. In selecting seed, not only the head, but the whole plant producing the head, should be taken into consideration. A vigorous plant with some 6 to 12 tillers each having a good head should be chosen in preference to a plant having one culm and large head.

Rate of seeding with drill.—The small-grained varieties of wheat, like Siberian No. 1, should be seeded at the rate of 1 bushel (60 pounds) per acre. Larger-grained varieties, like Romanow, should be seeded at the rate of 75 pounds per acre. Barley should be seeded at the rate of 80 pounds per acre, oats for grain 90 pounds, and oats for hay 3 bushels.

Broadcasting.—In broadcasting seed, the above-mentioned quantities of seed should be increased by half a bushel in each instance, to allow for seed that is left uncovered.

Treatment for smut.—Grains are subject to smuts of various kinds, stinking smut of wheat being the form doing the most damage. One should strive to use clean seed. When that can not be had, the seed should be treated to kill all spores adhering to it. A drill which has been used to sow infected seed should be thoroughly disinfected before treated seed is run through it. A most effective treatment for wheat is to dissolve a pound of copper sulphate crystals (bluestone) in 20 gallons of water and immerse the seed in gunny sacks in the solution for 12 hours. The seed should then be transferred to a solution made by slaking a few pounds of lime in a small quantity of water, and gradually adding more water until the solution has been diluted about 20 times. After remaining in the lime solution for about 5 minutes, the seed should be spread on a floor until sufficiently dry to run through the drill.

The use of copper carbonate dust for the control of stinking smut of wheat is highly recommended by many experimenters, but it has

FIG. 8.—Harvesting Canadian oats with tractor, Fairbanks station

not yet been tested at the Alaska stations. The treatment consists of thoroughly mixing 2 ounces of fine, dry copper carbonate with each bushel of wheat to be treated. The use of a tight revolving barrel or similar device is recommended, as the dust is irritating if breathed. This treatment does not require any drying of seed, and is claimed to stimulate germination.

Smuts of barley and oats are of two kinds—covered smut and loose smut. Covered smut attacks only the kernels, whereas loose smut attacks the whole spikelet. Covered smut can be effectively treated by either of two methods, the simpler and less expensive being the hot-water treatment. One should have a reliable thermometer to gauge the temperature of the water, and two barrels of water, one of which should be heated to a temperature between 120° and 125° F., the other between 133° and 135° F. The temperature is of course best regulated by steam, when that is available. Sacks containg the grain should be immersed in the water having a temperature rang-

ing from 120° to 125° until the seed is thoroughly warmed. The seed should be then immersed in the water having a temperature of 133° for 10 minutes, and spread on a floor to dry sufficiently to run through the seeder. The seed should be sown immediately. The hot-water treatment is simple and has the advantage of facilitating germination.

In the second method, for oats, the seed is soaked in a formaldehyde solution, using 1 pound, or pint, of 40 per cent commercial formaldehyde to 20 gallons of water. The seed is placed in a gunny sack and immersed in the solution for 20 minutes, then removed, dried, and sown immediately. In the case of barley, the formaldehyde should be used at the rate of 1 pound to 40 gallons of water.

Harvesting.—All grain should be harvested as soon as it ripens, or, if necessary, before it fully matures. Ordinarily grain can not be allowed to harden as it does in the more southern latitudes. Advantage must be taken of every good day to insure harvesting the whole crop before frost. Set the binder to work even though the grain is not so fully mature as could be desired. This will, of course, depend somewhat upon the quantity that is to be harvested and the time required. The stations have demonstrated that grain does not necessarily have to be fully mature to be 100 per cent viable. Wheat for milling should, however, be as nearly fully ripe as the season will permit before harvesting. The tractor will prove a satisfactory source of power for harvesting and will do more work with the binder than a team can do. Harvesting requires special attention when it must be done under abnormal conditions. The crop should be cut with a cradle if it has lodged badly, and without delay if it is nearly ripe, unless, of course, it is intended only for hay. Lodging is usually caused by weak straw, and varieties that fail to stand up under normal weather conditions had better be eliminated from culture. Lodged grain does not dry and grain must be thoroughly dry before stacking. Green or wet grain should usually be placed on a rack to dry. The curing rack at the Fairbanks station is simple in construction (fig. 4). It consists of two tripods of poles set in the ground, carrying poles in tiers, the first resting a foot above ground with a second tier about 4 feet above the first, and a final pole at the top of the tripod. This arrangement permits of free circulation of air through the grain. Another kind of rack, which is especially well suited to peas or crops that are not bound in sheaves, can be made by setting in the ground a number of posts, each 7 feet high, about 5 feet apart. Wooden pegs are set in holes bored for the purpose and are held at an angle above the horizontal. The sheaves are hung on these pegs, heads down, to cure.

YIELDS

Earliness is the one indispensable feature of varieties of grain for the interior. Yields are of secondary importance. Within the frost-free period, rarely more than 100 days, all grain must be seeded, develop, and mature seed. The plan of the stations, then, has been to find varieties that can be depended upon to mature before fall frosts. Late varieties, which are always larger and more vigorous than early varieties, have matured and yielded at a high rate in very

favorable seasons. However, it is the early varieties which must be depended upon in the interior. Yields calculated from results on a small trial patch may be very misleading. Large yields have been obtained at the stations; as, for instance, at the rate of 42 bushels of spring wheat per acre on a one-fourth-acre plat, and 79 bushels of oats per acre on a field scale, but these yields are exceptional. Mention might also be made of fields producing between 15 and 25 bushels of spring wheat and as much as 50 bushels of barley per acre. Barley and oats, except for the quantity intended for seed, are usually cut for hay. Grain yields in Alaska depend largely upon four factors—season, exposure, the amount of moisture available for the crop, and

FIG. 9.—Wheat field, J. D. McIntyre's ranch, near Fairbanks. Yield, 20 bushels per acre, Siberian No. 1

the variety of grain grown. Where these factors are favorable the yields will always be satisfactory. Grain growing at the stations has been chiefly confined to small plats on newly cleared land. No effort has been made to produce crops for market. New land is "spotted" and does not give the best results until it has been thoroughly subdued. On farms where grain is grown for market the yields, in most instances, are comparable with those obtained in Oregon or Washington on nonirrigated land. (Fig. 9.) The problem of the farmer is so to manage the farming operations that the controlling factors will cooperate with one another to the best possible advantage.

MAINTENANCE OF SOIL FERTILITY

The soils over the Territory as a whole can not be said to be extraordinarily fertile. There are large areas of rich land in the Yukon, Tanana, and Matanuska Valleys, but their fertility is not inexhaustible. Continually growing grain crops on the same land year after year without the application of fertilizers will soon use up the immediately available plant food, after which it becomes necessary to let the land rest or to resort to fertilizers to maintain good crops. As yet little effort has been made to improve the soils of Alaska, largely because of the limited supply of barnyard manure and the almost prohibitive cost of artificial fertilizers laid down in the interior farming districts. Most of the farmers have only recently learned the value of rotation and the important part that legumes play in rotation. Some of them have followed the practice of summer fallowing every second year. During the idle year it is true that the land is enriched in nitrogenous matter, and put in good physical condition and tilth for crop production the year following; but it is likewise true that each year of fallowing is one without returns. The land should be made to produce a crop every year. Fertility can be maintained only by the application of fertilizers, the practice of a systematic rotation, and the growing and plowing under of green manure crops.

During the early days of the Fairbanks station potatoes were grown in rotation with grain crops. This had about the same effect on the land as summer fallowing and afforded a crop which met with ready sale. The cultivation of the potato crop kept down weeds and left the land in good condition for grain the following year. This system of rotation can be followed only when there is no danger of over-production of potatoes, and in most localities farmers are turning to leguminous crops as better agencies for maintaining the fertility of the soil.

Leguminous crops.—Leguminous crops can be made to take the place of the more expensive fertilizers and to meet the requirements of the farmer for hay and pasture. The legumes that have been under experiment to determine their practicability as soil renovators include sweet clover, red clover, four or five varieties of vetch, and peas. Sweet clover has been eliminated because of its unsatisfactory growth. Red clover has made vigorous growth at the Fairbanks station during some years, but has had to be treated as an annual because it winterkills. Red clover does not mature seed in Alaska, and seed must therefore be shipped in. Nevertheless, when field peas and spring vetches are not available, seed of the Mammoth red clover can be sown in the spring and the crop plowed under in late August or early September. Of the several vetches tried, the common spring vetch appears to be the best, chiefly because it will mature a crop of seed each year. The vetch experiments are by no means complete, however, and it is a little early yet to pass judgment upon their merits. The value of the pea crop has been thoroughly demonstrated. It invariably gives good results. The important problem is how to produce varieties maturing seed before frost. Few farmers can afford to ship in field peas at 6 cents a pound plus freight charges. The varieties of peas differ in vigor

and earliness in maturing seed. A strain of the Canada field pea matured seed at the Matanuska station in the summer of 1924. Another variety, originally sold as a garden pea and known commercially as "Alaska," is among the earliest peas known. It has matured seed for several years both at the Rampart and the Fairbanks stations, and has been used as a field pea. This is mentioned merely to show that garden peas can be grown for green manure. Plowed under in the fall, the Alaska variety increased the vigor of wheat sown the following spring, resulting in larger heads, longer straw, and a decidedly larger yield than was obtained from adjoining plats which were not fertilized by a green-manure crop. The development of a vigorous-growing, early-maturing field pea perpetuating itself by seed production will have a very important bearing on the future of grain growing in Alaska.

Rotation.—Rotation is essential to successful grain growing. It has been practiced at the station in the sense that no one crop has been grown twice in succession on the same land. No fixed scheme of rotation has as yet been adopted. However, some system should be adopted and followed invariably. The system will of course depend upon the nature of the soil, the lay of the land, market demands for certain crops, the need of pastures, and the availability of seed. Assuming that grain and forage for dairy stock are to be the leading field crops in the interior, it might be well to employ a four-year rotation, growing legumes, grain, potatoes, and hay crops in the order mentioned. Regardless of the system used, grain crops must be rotated with legumes, pasture, and cultivated crops for best results.

A simple four-year rotation, including wheat, legumes, barley or oats, and potatoes or other root crops, would likely prove suitable to mixed farming where a herd of cattle and some sheep are raised. If 60 acres are under cultivation, the area can be subdivided into four tracts of 15 acres each, and be cropped in the order indicated above. Wheat would be mainly a cash crop. Peas and vetches could be grown as the legumes, in which case the farmer should aim to grow his own seed. The barley and oats might be seeded for stock feed, and the potatoes should bring cash if a market is assured for so large an area. Root crops, grown for feed, should consist chiefly of mangels. When potatoes or some of the other root crops are not wanted, garden vegetables, sugar beets, or similar crops requiring a small area, can be grown. Part of the legumes should be cut for hay and part should be devoted to seed production. If the legumes are inoculated so as to produce an abundant supply of root nodules, the stubble can be plowed under with almost as beneficial results as would be had from turning under the whole green crop. The slope of the land should always be considered in adopting a rotation.

THE HOME MARKET

Inquiry is often made as to the chances of marketing agricultural products in Alaska. Alaska annually imports from the States, chiefly from Seattle, Washington, more than $5,000,000 worth of agricultural products which could be produced locally. Table 2

shows the kind and value of farm products which were imported from the States in 1924:

TABLE 2.—*Agricultural products shipped from the States to Alaska in 1924* [1]

	Quantity	Value		Quantity	Value
Beef and veal ..... pounds	3,888,668	$578.121	Barley ..... bushels	4,621	$4,388
Beef (canned) ..... do	171,375	32,210	Corn ..... do	3,294	4,234
Beef (pickled) ..... do	130,715	12,374	Meal ..... barrels	2,128	12,495
Ham ..... do	969,004	254,430	Oats ..... bushels	120,514	76,191
Bacon ..... do	810,782	232,026	Oat meal ..... pounds	543,136	27,525
Pork ..... do	1,962,283	168,485	Wheat ..... bushels	2,585	3,218
Mutton ..... do	493,093	97,908	Flour ..... barrels	49,253	332,238
Sausage ..... do	303,898	59,447	Hay ..... tons	3,732	94,186
Poultry and game ..... do	346,136	110,572	Mill feed ..... do	1,858	74,763
Other meat products ..... do	303,967	49,374	Oil meal ..... pounds	67,912	1,455
Eggs ..... dozen	1,515,824	546,225	Vegetables		797,253
Milk ..... pounds	5,040,192	481,293	Potatoes ..... bushels	125,571	158,754
Butter ..... do	1,522,504	688,727	Onions ..... do	18,082	35,625
Cheese ..... do	294,487	88,912			
Lard ..... do	481,939	75,877	Total		5,146,222
Lard compounds ..... do	309,463	47,916			

[1] These figures were obtained from the United States customs service, Juneau.

The annual consumption of over $5,000,000 worth of agricultural products, of which $650,000 is paid for cereal and allied products, in addition to the unknown amount locally grown, would seem to indicate conclusively that Alaska has good market possibilities for home-grown products. It should be noted in this connection, however, that locally grown products will have to compete on the market with imported products, and probably at a slight reduction in price. However, there should still be a good margin of profit, because of the additional expense in freighting and handling imported products. If the Alaska farmer can not readily sell his agricultural products, his problem is one of distribution, not of market.

A few years ago the Farmers' Agricultural Association of Fairbanks purchased a flouring mill having a capacity of 25 barrels a day. It ground all the wheat grown in the Tanana Valley and could have handled more had it been available. The 1922 wheat crop was a failure and the mill stood idle. The 1923 crop was negligible and the farmer had to import seed wheat for the 1924 crop. The area in wheat was therefore smaller than could have been produced.

Prices in Alaska are of course increased by the cost of freight between the port of Seattle and the terminus of shipment. The ocean freight from Seattle to Seward is $12 per ton. On hay or straw it is $21.50 for single compressed bales. If this sum is added to the original cost, the price paid for hay and straw in Seattle is upwards of $40 per ton. The price is further increased, if there are added to it charges for freight, depending upon the distance carried, and charges for cartage over wagon roads and trails to the ultimate point of consumption. Such prices should enable the Alaska farmer to make a good profit on his surplus grain, hay, feed, or wheat.

CLASSIFICATION OF WHEAT AS TO SEASON OF MATURITY

It has already been stated that only early maturing varieties can be depended upon to mature with certainty in Alaska. Of the

many that have been tested at the several stations, comparatively few can be recommended for general culture. For the sake of convenience these have been classified as "early," "medium early," and "late." In 1899 and 1900 small patches of wheat were grown at the Sitka station. These two seasons were favorable, in that the late summer and fall were not too wet to mature grain. At the latitude of Sitka, 57° 03′, there is no danger of grains being destroyed by frost. The varieties grown were Romanow and Ladoga, both of Russian origin, seed being obtained from the United States Department of Agriculture. The varieties are practically alike. Both are bearded, have brown chaff, and large, plump kernels, and are fair yielders. Ladoga, however, has a somewhat more open head than Romanow. These wheats are medium early and mature in three out of four years. They have remained in cultivation at the stations,

FIG. 10.—Russian spring wheat, Siberian No. 1 (Khogot), Fairbanks station

and surplus grain of Romanow has been distributed among the farmers by the Rampart and the Fairbanks stations; it is also grown in the Matanuska Valley.

Early Siberian spring wheats.—In 1913 samples of a number of spring wheats were obtained from the experiment station at Tulun, Province of Irkutsk, Siberia. Among them were the varieties H. G. and Khogot, afterwards erroneously spelled "Chogot," and now known as Siberian No. 1 to indicate the place of its origin. (Fig. 10.) Siberian No. 1 is the earliest variety of spring wheat tested at the Alaska stations and has been given the preference for general culture among the farmers of the Tanana Valley. It is a dwarf, bearded, semihard variety, with normal heads averaging 2½ inches in length, small kernels, and brown chaff. It does not compare in appearance with Romanow, but grown under identical conditions makes

a better yield. H. G. is a dwarf, bearded variety having white chaff and light yellow kernels. The introduced varieties were grown at the Rampart station in 1914 and matured perfectly. In 1915 increase plats were seeded, and in 1916 the yields were large enough to permit of a distribution of seed among the farmers of the Tanana Valley. Siberian No. 1 was an unqualified success from the start, and was practically the only variety sown in the Tanana Valley in 1917 and 1918. The farmers called it the Tanana Valley Red and were so encouraged by its success that they installed a flour mill at Fairbanks. Siberian No. 1 matured in less than 100 days from seed. It has ripened in 84 days at Rampart, which is located in latitude 65° 30′, and in an unfavorable season at Fairbanks in 110 days. In good soil and in a favorable season it will yield between 20 and 30 bushels

FIG. 11.—Romanow spring wheat, Fairbanks station

per acre. It is superior to Romanow, Ladoga, and other varieties in the farmers' opinion. Next in earliness come the varieties Ulka, H. G., Beta, Eta, Omega, Irkutsk, and Tulun, also of Russian origin. These varieties are not, however, good yielders and have not been introduced into general culture. Siberian No. 1 has been improved since its introduction by pedigreed selections, so that the stock of seed now on hand is superior to that originally received. At this writing, Siberian No. 1 is the only variety meriting attention as an early spring wheat grown on a field scale. Romanow (fig. 11) although not of equal rank with Siberian No. 1 in point of earliness, has nevertheless been classed with it, because of its success in the hands of farmers. It ripens 10 to 15 days later than Siberian No. 1, and can not be depended upon to mature except under very favorable conditions.

SOME VARIETIES TESTED AT THE STATIONS

All of the following-named varieties have been tested at the stations and have been rated as to earliness on the basis of these tests.

SPRING WHEAT

Early varieties.—These include Siberian No. 1 (Khogot), Irkutsk, Beta, Eta, Tulun, Omega, No. 306 (designation under which received), which are of Siberian origin, and, except in very unfavorable seasons, can be counted on to mature before frost in the interior.

Medium early varieties.—These include Romanow (S. P. I. No. 8892), Ladoga, Ruby, Marquis, Prelude, Red Bobs, Preston, Champion, and Early Riga, which will mature in an average summer

FIG. 12.—Shock of Hogot, winter rye, Rampart station

in the interior but are likely to fail when the summer is cold and cloudy.

Late varieties.—These include Early Baart, Sunset, Velvet Chaff, Red Fife, Borsom, Power, Kota, Kota×Marquis, Pioneer, Wellman, Glyndon, Houston, Haynes Bluestem, Federation, White Federation, Hard Federation, Converse, Farley, Kitchener, Ebert, Stanley, Harold, Arnautka (*Wild Goose*), Duffering, and Plumper, none of which will mature in the interior unless the season is unusually favorable with warm summers and an abundance of clear weather.

WINTER WHEAT

No variety has as yet been found to survive the severe winters of the interior. Kharkof, the hardiest variety tried, has been seeded repeatedly and may survive sufficiently to make a 50 per cent stand in the spring if it has been protected with a covering of 3 feet of

snow. Without this covering, however, the crop invariably winterkills. Selected kernels from the small proportion of heads surviving were seeded in the hope of developing a hardy strain. As yet, however, there has been no improvement in hardiness. Other varieties tried include Kanred, Sandomirka, Malakov, Turkey Red, Red Rock, and Fortyfold. These are supposed to be hardy, but they do not survive the winter.

WINTER RYE

Several varieties of winter rye have been grown for a number of years at the Rampart station and nearly all are hardy when the field is covered with a light layer of snow. Winter rye will probably never be a popular crop with Alaska farmers, as it takes 13 months to mature. The seed must be sown in the latter part of July or the early part of August to establish a crop before frost, and it usually

FIG. 13.—Hybrid barley, No. 19b, grown at Fairbanks station

can not be harvested until the latter part of August or beginning of September of the following year. Hogot (fig. 12), a variety which came from Russia, is superior to all others tested for vigor, hardiness, and length of head, and in these qualities is closely followed by Irkutsk. Some of the varieties more commonly grown in the States and tested at Rampart include Giant French, Amber, Brandon, Swedish, Rosen, and commercial sorts, all of which winterkill unless protected by snow.

BARLEY

Barley matures in a shorter season than do either spring wheat or oats and is therefore par excellence the crop for northern latitudes. (Fig. 13.) Most of the varieties in common culture can be depended upon to mature in an average season, and the value of any given variety depends therefore less upon earliness than upon other qualities. Most barleys have weak straw and if grown in rich soil are likely to lodge, producing poorly developed grain and making a partial crop. Bearded barleys lodge more readily than do the

beardless sorts. The beards are objectionable in stock feed when the crop is grown for hay and they help to cause breaking of the straw and lodging of the grain by catching wind and moisture. To be desirable, barley should have straw sufficiently stiff to withstand the storms that may occur during the growing season. It is rarely sown for hay in Alaska, because oats are much better for the purpose. In northern Europe the grain is largely used as a food for man, but in Alaska it is used only for feed. There is no large demand for the crop for the reason that there are few herds in these regions as yet, and therefore there is not much need for grain for stock feeding. Barley is, however, destined to take the place of corn in these latitudes where corn can not be grown, and farmers would do well to familiarize themselves with its merits.

Table 3 gives a list of the varieties of barley that have been tested at the stations. All the varieties are bearded and six-rowed unless otherwise described.

TABLE 3.—*Barleys tested at the stations*[1]

Name	Remarks
EARLY MATURING VARIETIES	
Abyssinian (G. I. No. 362)	Black; 2-rowed; bearded.
Bodoe (G. I. No. 568)	Bearded; straw, weak.
Boehmer (S. P. I. No. 19851)	Beardless; hull-less.
Champion	Hooded.
Eagle	Bearded; straw, stiff; 2-rowed.
Finland (G. I. No. 582)	Bearded.
Feldnaes (G. I. No. 561)	Do.
Hansen (G. I. No. 279)	Do.
Hull-less (S. P. I. No. 12709)	Beardless; hull-less.
Lapland	Bearded.
Liland (G. I. No. 565)	Bearded; straw, weak.
Highmore	Beardless.
Muljord (G. I. No. 564)	Bearded; straw, stiff.
Manshury (Manchuria)	Bearded; commercial variety.
Pamir (Kashgar) (S. P. I. No. 18922)	From Pamir Mountains.
Primus	Bearded; straw, stiff; 2-rowed.
Stroemmen (G. I. No. 562)	Bearded; straw, weak.
Success	Hooded; straw, weak.
Svalof (G. I. No. 560)	Bearded.
Swedish (S. P. I. No. 19557)	Do.
Yakutsk (G. I. No. 574)	Bearded; straw, weak.
Wyoming	Hooded.
Trysil (G. I. No. 566)	Bearded.
Scottish Pearl	Bearded; straw, stiff.
MEDIUM EARLY VARIETIES	
Beardless (S. P. I. No. 19852)	
Black Hull-less	Bearded.
Chevalier	Bearded; 2-rowed.
Finnish (G. I. No. 581)	Bearded.
Gold	Bearded; 2-rowed.
Gray Maryle	Bearded.
Hannah (S. P. I. No. 9133)	Bearded; 2-rowed.
Oderbrucker (S. P. I. No. 10754)	Bearded; straw, weak.
Odessa	Bearded.
Royal	Do.
Urjala	Finnish origin; straw, stiff; 2-rowed.
Sisolk	Bearded.
Trooper	Do.
LATE MATURING VARIETIES	
Bark	Bearded; 6-rowed.
Dönnes	Do.
Mjös	Do.
Moskin	Do.

[1] The figures accompanying the letters G. I. and S. P. I. in this and other tables indicate the number under which the varieties were recorded in the Office of Cereal Investigations, and the Office of Foreign Seed and Plant Introduction, United States Department of Agriculture, whence they were obtained. Varities not so designated were obtained from various other sources.

Few of these varieties can be recommended for general planting in Alaska. Manshury, the standard variety, is perhaps the best of the bearded types. The stations have developed a series of hybrids, some of which are better suited to Alaska than are varieties coming from the States. These hybrids are noted in the list given on page 32.

OATS

Oats mature later than barley does. In Table 4 are listed varieties which have been tried at the stations:

TABLE 4.—*Oats tested at the stations*

Name	Remarks
EARLY MATURING VARIETIES	
Burt Extra Early	Poor yielder, hence discarded.
Copperfield	Gray; vigorous grower; lodges.
Crown (Swedish)	White; resembles Banner.
Finnish Black	From Finland. This is the earliest oat at the stations. It makes vigorous growth, attaining a height of 5 feet, has open panicles, and stiff straw. It seldom lodges, but has rather small, slender kernels.
Kherson	Yellow; lacks vigor.
Lincoln	White; commercial variety.
Norwegian (G. I. No. 500)	Excellent variety; can be counted on to mature.
Sixty-Day (G. I. No. 666)	White; often lodges.
South Dakota (G. I. No. 637)	Excellent variety; gray.
Swedish Golden (S. P. I. No. 20460)	
Victory (Swedish)	White.
Yakutsk (G. I. No. 498)	White; not a vigorous grower.
MEDIUM EARLY VARIETIES	
Appler (Red Rustproof) (No. 339, California)	
Banner	Commercial variety; often lodges.
Black Bell (S. P. I. No. 20463)	Black; discarded.
Beliak	Siberian yellow variety.
Canadian (No. 444, California)	Excellent yielder.
Climax	Commercial variety; white.
Early Champion	Commercial variety.
Eclipse	Side oats; white.
Gold Rain	Yellow variety.
Golden (S. P. I. No. 20460)	
Hansen (S. P. I. No. 24477)	Vigorous grower.
Hull-less	From Pullman, Wash. White.
Irish Victor	Commercial variety.
Leader	Side oat; vigorous grower.
Ligowo (S. P. I. No. 20459)	White; kernels, plump; lodges.
Minnesota (G. I. No. 261)	Black.
Prosperity	Commercial variety; white.
Russian (S. P. I. No. 10642)	Discarded.
Silvermine	Commercial variety.
Swedish Posita	White.
Swedish Select (S. P. I. No. 10557)	Plump; white.
Swedish White (S. P. I. No. 18245)	
LATE MATURING VARIETIES	
Belyak (S. P. I. No. 10624)	Black oats.
Black Great Mogul (S. P. I. No. 20464)	Unsuited to Alaska.
Black Tartarian	Side oat; black; vigorous grower; good for hay.
Celog I	Yellow oats.
Celog II	Do.
Grenadier	White oats.
Hvitling (S. P. I. No. 20458)	Unsuited to Alaska.
No. G. I. 278	Large; white oats.
Odin	White oats.
Ontario	Do.
Pearl	Do.
Polar	Commercial variety; white.
Probsteir (S. P. I. No. 20461)	
White Probsteir (S. P. I. No. 20462)	
Swedish Black (S. P. I. No. 20464)	
Thor	White oats.
Tartar King	Commercial origin.

Early oats that can be depended upon to mature are Finnish Black (fig. 14), Norwegian, South Dakota, and some others of less merit. The medium early varieties Ruoevesi, Korbjohi, Toholampi, Orismala, and Soanlahti are black. They came direct from Finland and were discarded after being tested at Rampart. Late varieties are not recommended for general planting for grain, but they are better adapted to hay than the early sorts because of their larger and more vigorous growth.

HYBRIDIZATION WORK

The stations have been working intermittently since 1907 to develop varieties of grain combining the quality of earliness with the

FIG. 14.—Finnish black oats, Fairbanks station

vigor, large heads, and good yielding qualities of the late maturing varieties. Earliness, however, was given the first consideration. Vigorous, heavy yielders which fail to mature until late are of no advantage to Alaska. Hybridization work was begun at the Rampart station, which is 1° south of the Arctic Circle, it being thought that varieties succeeding there could be grown in sections of the interior south of 65° 30′. The work has been carried on by, or under the immediate supervision of, Mr. Gasser. (Fig. 15.) Upon his transfer from Rampart to Fairbanks in 1921, Mr. Gasser continued the work of hybridizing grains, but the best hybrids originated at Rampart. As a result of his efforts, several varieties of spring wheat, barley, and oats have been originated, but comparatively few combine the qualities desired. The late-maturing parent

is very generally prepotent. Early maturity and vigorous growth seem to be incompatible. If they are found to some extent in the same plant, the straw will be weak.

BARLEYS

Barley No. 14b (fig. 16) is an excellent example of a hybrid which is desirable in some respects, but lacking in one or more of the essential qualities. It is the result of a cross made in 1911 between Hull-less (S. P. I. No. 19851), a six-rowed, beardless, medium early barley with rather weak straw, and the staminate parent Abyssinian (G. I. No. 362), a two-rowed, black, bearded, early variety which is noted for its stiff straw. Of the many and varied hybrids resulting from the cross, barley No. 14b is six-rowed and bearded, and has

FIG. 15.—Hybrid grains undergoing critical examination, Rampart station, 1916

heads ranging from 5 to 5¾ inches in length, exclusive of the beards. Could this barley stand up until maturity it would be one of the best; but it has weak straw, and as a result lodges and makes poor yields.

Hybrid barley No. 19 (fig. 17), obtained from crossing hybrid No. 1, the result of the first cross in 1907, with the staminate parent Hull-less (S. P. I. No. 12709), a six-rowed, beardless, and hull-less variety, is, on the other hand, an example of a combination of desirable characters, and is likely to become a leading barley in the interior. The mother of hybrid No. 1 is Champion, a strong-growing, six-rowed, beardless variety, and the staminate parent is Pamir (S. P. I. No. 18922), a very early, bearded, six-rowed, variety with weak straw and small heads. The cross was made for earliness and increased yield. Hybrid No. 1 is medium early, has larger heads than Pamir, prominent hoods, and straw that is not so stiff as could be desired. Of the many types resulting from the cross, two selections, both six-rowed, hull-less, and beardless, were made. One has

dark and the other light glumes. Both are vigorous growers, have remarkably stiff straw, and are early to medium early, being only little later than is the staminate grandparent Pamir. The type with dark glumes has the larger heads.

FIG. 16.—Barley hybrid 14b. Rampart station, 1921

Types of barleys Nos. 20, 28, and 68 (see parentage, pp. 34 and 35) are deemed valuable because of their earliness and stiff straw combined with fair yields.

OATS

Crossbreeding of oats, undertaken as in the case of barley to develop early-maturing, vigorous-growing varieties having stiff straw, has resulted in the production of several valuable hybrids. Hybrid No. 25, for example, the result of a cross between Copperfield and Toholampi as the staminate parent, which is almost identical with

Finnish Black and came direct from Finland, will likely be a valuable variety for hay and silage as well as for grain, because of its vigorous growth, stiff straw, and heavy leafage. It ranks in the early group. Oat No. 25 did not show any remarkable qualities at Fairbanks, but in the richer soil at Matanuska it attained a height of 5½ to 6 feet and matured medium early. It is a gray oat with medium plump kernels.

Hybrid No. 36, the result of pollinating Black Tartarian with Yakutsk (G. I. No. 498), an early, white Siberian variety having stiff straw, is earlier than the mother, and has white grain like the staminate parent, but makes a more vigorous growth.

Several types of hybrid No. 51 promise to be of much value. (Fig. 18.) Oat No. 51 is the result of a cross between a multiflorous, hull-less oat, which came originally from the experiment station at Pull-

FIG. 17.—Barley, Hybrid No. 19–3. Grown at Rampart station

man, Wash., and Norwegian (G. I. No. 500), an early, black variety. The types are hull-less and being earlier than the mother are better adapted to Alaska. It is thought that the clean white, hull-less seed can be used as a breakfast food without being milled.

WHEAT

None of the wheats so far tested can compare in earliness with Siberian No. 1 (Khogot). It is apparently a very high quality of hard wheat but has small kernels and is of dwarf growth. A number of crosses were made to produce strains showing greater vigor and equal earliness. Hybrid No. 30, the result of a cross made in 1914 between Siberian No. 1 and Marquis is the best produced to date, and has excellent milling qualities (fig. 19). However, it matures too late for Alaska, except under very favorable conditions.

FIG. 18.—Oats hybrid 51a with parent plants in center. Six-inch rule. Rampart station

Of the many variations produced by this cross, hybrid No. 30a gives promise of becoming a valuable wheat for Alaska. It is more vigorous and has larger heads and kernels than Siberian No. 1, and although somewhat later than the mother, it is early enough to mature in normal seasons. These hybrids will be grown on a field scale as soon as seed becomes available, so that they can be thoroughly tested.

FIG. 19.—Spring wheat, Hybrid No. 30–a. Grown at Rampart station.

Hybrid No. 62, also the result of a cross between Siberian No. 1 and Marquis, has produced some types from which promising strains may be isolated.

LIST OF HYBRIDS

The following list of hybrids was prepared by Mr. Gasser. The figures indicate the number of the cross, and the letters the selection from the cross; thus, 30a indicates the first generation from station-grown seed of the thirtieth cross.

BARLEY HYBRIDS

Hybrids Nos. 1a–c: Champion × Pamir (S. P. I. No. 18922). Oroginated in 1907.

Description of parents: Champion, hooded, 6-rowed; straw, weak; medium early. Pamir (S. P. I. No. 18922), bearded; heads, short; 6-rowed; straw, short and stiff; very early.

Description of hybrids: Heads, large, well-filled; hooded; glumes, purple; straw, weak. This series, while poor for field purposes, was of value as a parent in later crosses, notably in the 19, 20, and 21 series. Discontinued.

Hybrid No. 2a: Hull-less (S. P. I. No. 12709) × Finland (G. I. No. 582). Originated in 1909.

Description of parents: Hull-less (S. P. I. No. 12709), hooded; 6-rowed; straw, medium stiff; medium early. Finland (G. I. No. 582), bearded; 6-rowed; straw, medium stiff; medium early.

Description of hybrids. None of value. Discarded.

Hybrid No. 3a: Hull-less (S. P. I. No. 12709) × Swedish (S. P. I. No. 19557). Originated in 1909.

Description of parents: Hull-less (S. P. I. No. 12709), see Hybrid No. 2a. Swedish (S. P. I. No. 19557), bearded; 6-rowed; straw, weak; early.

Description of hybrids: None of value. Discarded.

Hybrid No. 4a: Chittyna × Oderbruker. Originated in 1909.

Description of parents: Chittyna, hooded; 6-rowed; straw, medium stiff; medium early. Oderbruker, bearded; 6-rowed; straw, medium stiff; medium early.

Description of hybrids: Hooded, yellow; 6-rowed; straw, medium strong; medium early. This series was not a high yielding sort. In 1917 it produced 27.7 bushels per acre; in 1919, 19.8 bushels; in 1920, 19 bushels, and in 1921, 20.8 bushels per acre. Discontinued because of low yields, rather weak straw, and hoods longer than are desirable.

Hybrid No. 5a: Chittyna × Abyssinian (G. I. No. 361). Originated in 1909.

Description of parents: Chittyna, see Hybrid No. 4a. Abyssinian (G. I. No. 361), bearded; 6-rowed; straw, stiff; medium early.

Description of hybrids: Heads, rough; straw, weak. Medium early. Discarded.

Hybrid No. 6a: Hull-less (S. P. I. No. 12709) × Abyssinian (G. I. No. 360). Originated in 1909.

Description of parents: Hull-less (S. P. I. No. 12709), see Hybrid No. 2a. Abyssinian (G. I. No. 360), bearded; 6-rowed; straw, stiff; medium early.

Description of hybrids: Hoods, excessively long. Discarded.

Hybrid No. 7a: Hull-less (S. P. I. No. 12709) × Manchury. Originated in 1910.

Description of parents: Hull-less (S. P. I. No. 12709), see Hybrid No. 2a. Manshury, bearded; 6-rowed; straw, stiff; medium early.

Description of hybrids: Hoods, excessively long. Discarded.

Hybrids Nos. 8a–b: Hull-less (S. P. I. No. 12709) × Hansen (G. I. No. 279). Originated in 1910.

Description of parents: Hull-less (S. P. I. No. 12709), see Hybrid No. 2a. Hansen (G. I. No. 279), bearded; 6-rowed; straw, medium to weak; early.

Description of hybrids: Hoods, excessively long; rachis, brittle. Discontinued.

Hybrid No. 9a: Eagle (Primus) × Pamir (S. P. I. No. 18922). Originated in 1910.

Description of parents: Eagle, or Primus, bearded; 2-rowed; straw, very stiff; medium late. Pamir (S. P. I. No. 18922), see Hybrid No. 1a.

Description of hybrids: All hybrids had small heads and were inclined to be sterile.

Hybrids Nos. 10a–b: Hybrid No. 1a–3–1 × Hansen. Originated in 1910.

Description of parents: Hybrid No. 1a–3–1, hooded; 6-rowed; straw, stiff; early. Hansen, bearded; 6-rowed; straw, medium to weak; early.

Description of hybrids: Heads, small; hoods, pronounced. Discarded.

Hybrids Nos. 11a–b: Koyukuk × Abyssinian (G. I. No. 360). Originated in 1910.

Description of parents: Koyukuk, hooded; 6–rowed; straw, stiff; early. Abyssinian (G. I. No. 360), bearded; 6-rowed; straw, stiff; medium early.

Description of hybrids: Heads, small; hoods, pronounced. Discarded.

Hybrids Nos. 12a–d: Hull-less (S. P. I. No. 12709) × Pamir (S. P. I. No. 18922). Originated in 1912.

Description of parents: Hull-less (S. P. I. No. 12709), see Hybrid No. 3a, Pamir (S. P. I. No. 18922), see Hybrid No. 1a.

Description of hybrids: None germinated.

Hybrid No. 13a: Koyukuk × Pamir (S. P. I. No. 18922). Originated in 1912.

Description of parents: Koyukuk, see Hybrids Nos. 11a–b. Pamir (S. P. I. No. 18922), see Hybrids Nos. 12a–d.

Description of hybrids: Heads, small and rough. Discarded.

Hybrids Nos. 14a–e: Hull-less (S. P. I. No. 19851) × Abyssinian (G. I. No. 362). Originated in 1911.

Description of parents: Hull-less (S. P. I. No. 19851), hull-less; hooded; 6-rowed; straw, inclined to lodge; medium early. Abyssinian (G. I. No. 362), bearded; 2-rowed; black; straw, stiff; early.

Description of hybrids: The progeny of this cross has shown marked diversity and vigor, 2-rowed and 6-rowed, yellow and black glumes, hulled and hull-less, and hooded and bearded types being represented. The size of heads in the bearded types is quite remarkable. Five selections have been made of this cross, but the yields have been rather low, probably due to growing the crop under poor field conditions. A bearded, hull-less type yielded in 1920 at the rate of 16.5 bushels per acre; in 1921, 39.1 bushels, and in 1923, 21.9 bushels. A 2-rowed type yielded 16.3 bushels per acre in 1920. The three types now being grown are hooded, 2-rowed, yellow; hooded, 2-rowed, black; and bearded, 6-rowed, black, hull-less.

Hybrid No. 15a: Hull-less (S. P. I. No. 19851) × Swedish (S. P. I. No. 19557). Originated in 1911.

Description of parents: Hull-less (S. P. I. No. 19851), see Hybrids Nos. 14a–e. Swedish (S. P. I. No. 19557), see Hybrid No. 3a.

Description of hybrids: Heads, small and imperfectly formed. Discarded.

Hybrid No. 16a: Hull-less (S. P. I. No. 12709 × Manshury. Originated in 1911.

Description of parents: Hull-less (S. P. I. No. 12709), see Hybrids Nos. 12a–d. Manshury, bearded; 6-rowed; straw, stiff; medium late.

Description of hybrids: Hybrids inclined to be sterile. Discarded.

Hybrids Nos. 17a–d: Hybrid No. 1a–1 × Finland (G. I. No. 582). Originated in 1912.

Description of parents: Hybrid No. 1a–1, hooded: 6-rowed; heads, large; straw, medium stiff; medium early. Finland (G. I. No. 582), bearded; 6-rowed; heads, short, dense, square, tapering; straw, stiff: early.

Description of hybrids: Heads, mostly rough and not early maturing. Selection No. 17c, now under test, is like the staminate parent minus the beards. The heads have short hoods, which is a desirable characteristic.

Hybrid No. 18a: Hybrid No. 3a–2–1 × Lapland. Originated in 1912.

Description of parents: Hybrid No. 3a–2–1, hooded; 6-rowed; straw, stiff; early. Lapland, bearded; 6-rowed; straw, stiff; medium early.

Description of hybrids: Not early enough. Discarded.

Hybrids Nos. 19a–b: Hybrid No. 1a–3 × Hull-less (S. P. I. No. 12709). Originated in 1912.

Description of parents: Hybrid No. 1a–3, bearded: 6-rowed; straw, stiff; glumes, striped; medium early. Hull-less (S. P. I. No. 12709), hull-less; hooded; 6-rowed; glumes, yellow; straw, medium stiff; medium early.

Description of hybrids: This series is early to medium early, hooded, hull-less, and nonsterile; heads, medium to large and nonshattering; rachis, nonbrittle; straw, stiff. White and dark glumed types have been selected because of their apparent adaptability to these latitudes. The dark-glumed type is the more vigorous of the two. The grain yields were at the rate of 21.4 bushels per acre in 1920; 40.9 bushels in 1921; and 40 bushels in 1922. At Rampart in 1923 the white type of No. 19–3 yielded at the rate of 30 (48 pounds to the bushel) bushels per acre, and the dark type, 23.5 bushels.

Hybrids Nos. 20a–b: Hybrid No. 1a–1 × Hansen. Originated in 1912.

Description of parents: Hybrid No. 1a–1, hooded; 6-rowed; straw, stiff; medium early. Hansen, see Hybrids Nos. 10a–b.

Description of hybrids: This series is hooded, hulled, 6-rowed, yellow glumed, and early. The final type selected has for its outstanding quality, earliness. In 1922 when most of the grains failed to ripen, No. 20b was ripe and harvested before the disastrous freeze came. It is rather a light yielder, but can be grown on a rich ground because of its stiff straw. In 1921 it yielded at the rate of 23.4 bushels per acre; in 1922, 33 bushels; in 1923, 32.8 bushels, and in 1924, 9.4 bushels on very poor land.

Hybrid No. 21a: Hybrid No. 1a–1 × Abyssinian (G. I. No. 362). Originated in 1912.

Description of parents: Hybrid No. 1a–1, see Hybrids Nos. 20a–b. Abyssinian (G. I. No. 362), see Hybrids Nos. 14a–e.

Description of hybrids: The type selected is 2-rowed, hooded, hulled, black, and is like its Abyssinian forbear minus the beards. However, it has larger heads, a longer exsertion, and better vigor. It is early, but has rather brittle rachis, which probably reduced the yields in 1921, when one plat produced at the rate of 10.4 bushels per acre, and another plat, 17.9 bushels per acre. In 1912 seven-eighths of an acre yielded at the rate of 40.6 bushels per acre.

Hybrid No. 22a: Hybrid No. 1a–1 × Pamir (S. P. I. No. 18922). Originated in 1912.

Description of parents: Hybrid No. 1a–1, see Hybrids Nos. 20a–b. Pamir (S. P. I. No. 18922), see Hybrid No. 1a.

Description of hybrids: Heads, small and rough. Discarded.

Hybrid No. 23a: Hybrid No. 3a–6–1 × Champion. Originated in 1912.

Description of parents: Hybrid No. 3a–6–1, hooded; 6-rowed; straw, medium stiff; early. Champion, hooded, 6-rowed; straw, medium stiff; medium early.

Description of hybrids: Heads, small and rough. Discarded.

Hybrids Nos. 27a–d: Hybrid No. 19b × Hansen (G. I. No. 279). Originated in 1913.

Description of parents: Hybrid No. 19b, hooded; 6-rowed; hull-less; straw, stiff; heads, large; medium early. Hansen (G. I. No. 279), see Hybrids Nos. 20a–b.

Description of hybrids: Discontinued.

Hybrids Nos. 28a–f: Hybrid No. 14e–1 × Hansen (G. I. No. 279). Originated in 1913.

Description of parents: Hybrid No. 14e–1, hooded; 2-rowed; straw, stiff; black; early. Hansen (G. I. No. 279), see Hybrids Nos. 20a–b.

Description of hybrids: Not so good a barley as No. 19–3, but a very desirable sort. Of the several strains selected the best is medium early, black, 6-rowed, and hull-less with stiff straw, and medium-sized, well-filled heads. In 1919 it yielded at the rate of 23.6 bushels per acre; in 1920, 10.5 bushels; in 1921, 40.8 bushels; and in 1923, approximately 50 bushels per acre.

Hybrids Nos. 44a–c: Hybrid No. 20b–1 × Pamir (S. P. I No. 18922). Originated in 1915.

Description of parents: Hybrid No. 20b–1, hooded; 6-rowed; hull-less; straw, stiff; early. Pamir (S. P. I. No. 18922), see Hybrid No. 22a.

Description of hybrids: Heads small and rough with brittle rachis. Discarded.

Hybrids Nos. 65a–p: Highmore (No. 401) × Hybrid No. 20b–12–3–12. Originated in 1919.

Description of parents: Highmore (No. 401), beardless; 6-rowed; yellow; straw, stiff; heads, slender; early. Hybrid No. 20b–12–3–12, hooded; hull-less; yellow; 6-rowed; straw, stiff; early.

Description of hybrids: Disappointing as a series, having only earliness as a desirable quality. Heads mostly with long hoods and brittle rachis. Practically worthless.

Hybrids Nos. 66a–x: Highmore (No. 401) × Hybrid No. 20b. Originated in 1919.

Description of parents: Highmore (No. 401), see Hybrids Nos. 65a–p. Hybrid No. 20b, see Hybrids Nos. 65a–p. No difference except not hull-less.

Description of hybrids: Nothing of value.

Hybrids Nos. 67a–d; Hybrid No. 28e–3–22–1 × Highmore (No. 401). Originated in 1919.

Description of parents: Hybrid No. 28e–3–22–1, hooded; 6-rowed; hull-less; black; heads, large; straw, medium stiff; early. Highmore (No. 401), see Hybrids Nos. 65a–p.

Description of hybrids: Not superior to either parent. Discarded.

Hybrids Nos. 68a–v: Highmore (No. 401) × Hybrid No. 19–3. Originated in 1919.

Description of parents: Highmore (No. 401), see Hybrids Nos. 65a–p. Hybrid No. 19–3, hooded, hull-less; 6-rowed; dark.

Description of hybrids: This series exhibited such desirable characteristics as smoothnes of head, having neither hoods nor beards, and earliness. It is earlier than barley No. 19–3, but will probably not yield so well. The heads are slender like those of Highmore (No. 401). A selected staple strain will be seeded in increase plats. No yields were taken because the hybrids were grown on small plats.

OAT HYBRIDS

Hybrid No. 25a: Copperfield × Toholampi. Originated in 1912.

Description of parents: Copperfield, panicled; gray mutation of Finnish Black, at Copper Center station; straw, weak; early. Toholampi, panicled; black; straw, strong; like Finnish Black; early.

Description of hybrids: An early oat with panicled heads and medium plump, grayish kernels. Average number of kernels per head, between 50 and 75. Straw, strong. Grown on good ground this oat produces an abundance of leaves. Its earliness, vigorous growth, and strength of straw make it a desirable addition. In 1920 it yielded at the rate of 28.7 bushels per acre, and in 1921, 30 bushels per acre.

Hybrids Nos. 35a–g: Hybrid No. 25a–3 × South Dakota (G. I. No. 637). Originated in 1914.

Description of parents: Hybrid No. 25a–3, panicled; gray; straw, medium; early. South Dakota (G. I. No. 637), panicled; black; straw, stiff; early.

Description of hybrids: Only outstanding feature is earliness. The trial plats show no superiority over parents. One type selected has brown kernels, and another black. Both have panicled heads, and strong straw. Yields in 1920 were at the rate of 25.3 bushels per acre.

Hybrids Nos. 36a–f: Black Tartarian × Yakutsk (G. I. No. 498). Originated in 1914.

Description of parents: Black Tartarian, a side oat; black; straw, very stiff; late. Yakutsk (G. I. No. 498), panicled; white oat with small heads; straw, medium stiff; early.

Description of hybrids: Progeny exhibit considerable variation, but have stiff straw, and none lodge on rich ground. Three types grown were a white side oats, a black side oats, and a panicled white oats. One strain proved a light yielder, producing at the rate of 18.9 bushels per acre in 1920, and 25 bushels per acre in 1921.

Hybrids Nos. 51a–d: Hull-less (No. 304) × Norwegian (G. I. No. 500). Originated in 1916.

Description of parents: Hull-less (No. 304), panicled; multiflorous; white; straw, medium stiff; medium late. Norwegian (G. I. No. 500), panicled; black; straw, stiff but rather short; early.

Description of hybrids: Two types were established, one white and the other gray glumed, both hull-less and multiflorous. Black hulled kernels have been hard to eliminate, hull-less as well as hulled kernels (two or three to a head) producing like heads. Heads having triflorous, black hulled spikelets and kernels were easy to select, but the multiflorous heads having an occasional spikelet with black kernels were harder to find. The hybrids are early and desirable. In 1923, three plats yielded at the rate of 35.6, 43.5, and 43.5 bushels, respectively, per acre. At Rampart, on 0.08-acre plat, the yield was at the rate of 37.5 bushels per acre, allowing 32 pounds to the bushel.

Hybrids Nos. 52a–c: Hansen (G. I. No. 278) × Norwegian (G. I. No. 500). Originated in 1916.

Description of parents: Hansen (G. I. No. 278), panicled; white; heads, large; straw, coarse; beards, pronounced; late. Norwegian (G. I. No. 500), see Hybrids Nos. 51a–d.

Description of hybrids: Most of the progeny were discarded because they ripened late. A white and a black selection have been retained. Both have panicled, rather large open heads with beards and stiff, coarse straw like the staminate parent. Not among the earliest, but early enough.

Hybrids Nos. 76a–f: Oat No. 395 × Hull-less (No. 304). Originated in 1919.

Description of parents: Oat No. 395, side; black; beardless; kernels, plump; straw, stiff and vigorous; medium early. Hull-less (No. 304), see Hybrids Nos. 51a–d.

Description of hybrids: Seed failed to ripen. Discarded.

Hybrids Nos. 77a–c: Oat No. 395 × Yakutsk (G. I. No. 498). Originated in 1919.

Description of parents: Oat No. 395, see Hybrids Nos. 75a–f. Yakutsk (G. I. No. 498), see Hybrids Nos. 36a–f.

Description of hybrids: Seed failed to germinate. Discarded.

Hybrids Nos. 102a–s: Hybrid No. 51a–1–3–12 × Early Norwegian. Originated in 1923.

Description of parents: Hybrid No. 51a–1–3–12, panicled; multiflorous; white; straw, stiff; early. Early Norwegian, panicled; biflorous; kernels, very plump; straw, stiff; white, medium late.

Description of hybrids: F_1 generation only. All heads, side formation, large, and white. Spikelets, biflorous; straw, vigorous.

Hybrid No. 103a: Canadian (No. 416) × Hybrid No. 51a–1–3–12. Originated in 1923.

Description of parents: Canadian (No. 416), panicled; white; kernels, medium plump; straw, stiff; medium early. Hybrid No. 51a–1–3–12, see Hybrids Nos. 102a–s.

Description of hybrids: No seed germinated.

SPRING WHEAT HYBRIDS

Hybrid No. 24a: Red Fife × Ladoga. Originated in 1912.

Description of parents: Red Fife, beardless; straw, stiff; late. Ladoga, bearded; straw, stiff; medium early.

Description of hybrids: Heads, medium sized and bearded; glumes, light colored; kernels, large. All the offspring are lacking in earliness. Selections grown in 1923 ripened earlier than does either parent. A small plat yielded at the rate of 22 bushels per acre.

Hybrids Nos. 29a–v: Khogot (No. 133) × Irkutsk (No. 134). Originated in 1914.

Description of parents: Khogot (No. 133), bearded; heads, small; kernels, small, medium hard; straw, stiff and short; very early. Irkutsk (No. 134), similar to Khogot, but has lighter colored glumes.

Description of hybrids: Lacking in vigor and size of head. Discarded.

Hybrids Nos. 30a–p; Khogot (No. 133) × Marquis (No. 131). Originated in 1914.

Description of parents: Khogot (No. 133), see Hybrids Nos. 29a–v. Marquis (No. 131), beards, terminal; glumes, light colored; kernels, short; heads, medium size and open; straw, stiff; late.

Description of hybrids: Some of the progeny have heads of fine appearance, but earlier generations seemed to be somewhat more vigorous. Much of the best seed was lost in 1922, due to the unfavorable season. New selections were made, however, and there is now sufficient seed on hand to plant an acre. Grown on small plats, hybrid No. 30 is a trifle later in ripening that Khogot. It is satisfactory in this respect, however, and also in yield, stiffness of straw, and beardlessness. Yields were at the rate of 22.1 bushels per acre in 1921; 20 bushels in 1922, 18 bushels in 1923, and 16.5 bushels in 1924, when the crop was injured by rabbits.

Hybrid No. 32a: Khogot (No. 133) × Romanow (No. 127). Originated in 1914.

Description of parents: Khogot (No. 133), see Hybrids Nos. 29a–v. Romanow (No. 127), bearded; kernels, large; straw, stiff; glumes, dark; medium early.

Description of hybrids: Discarded.

Hybrids Nos. 33a–c: Khogot (No. 133) × H. G. (No. 82). Originated in 1914.

Description of parents: Khogot (No. 133), see Hybrids Nos. 29a–v. H. G. (No. 82), bearded; heads, small with light-colored glumes; kernels, small and light amber colored; straw, medium stiff; early.

Description of hybrids: Discarded.

Hybrid No. 40a: Irkutsk (No. 134) × Tulun (No. 306). Originated in 1915.

Description of parents: Irkutsk (No. 134), bearded; heads, small; kernels, small; straw, stiff, light; very early. Tulun (No. 306), like Irkutsk (No. 134).

Description of hybrids: Discarded. Conjugate generation, weak.

Hybrid No. 41a: Tulun (No. 306) × Khogot (No. 133). Originated in 1915.

Description of parents: Tulun (No. 306), see Hybrid No. 40a. Khogot (No. 133), see Hybrids Nos. 29a–v.

Description of hybrids: Discarded. Conjugate generation, weak.

Hybrid No. 53a: Romanow (No. 127) × Marquis (No. 131). Originated in 1916.

Description of parents: Romanow (No. 127). Like Ladoga, see Hybrid No. 24a. Marquis (No. 131), see Hybrids Nos. 30a–p.

Description of hybrids: Discarded. Too late.

Hybrid No. 54a: Marquis (No. 131) × Ulka (No. 81). Originated in 1916.

Description of parents: Marquis (No. 131), see Hybrids Nos. 30a–p. Ulka (No. 81), beardless; heads, broad at base, tapering; kernels, large; glumes, light colored. Medium early.

Description of hybrids: Too late. Discarded.

Hybrid No. 55a: Ulka (No. 81) × Khogot (No. 133). Originated in 1916.

Description of parents: Ulka (No. 81), see Hybrid No. 54a. Khogot (No. 133), see Hybrids Nos. 29a–v.

Description of hybrids: None germinated.

Hybrid No. 57a: Ulka (No. 81) × Romanow (No. 127). Originated in 1916.

Description of parents: Ulka (No. 81), see Hybrid No. 54a. Romanow (No. 127), see Ladoga, Hybrid No. 24a.

Description of hybrids: No seed germinated.

Hybrid No. 58a: Tulun (No. 306) × Romanow (127). Originated in 1916.

Description of parents: Tulun (No. 306), see Hybrid No. 40a. Romanow (No. 127), see Hybrid No. 24a.

Description of hybrids: No seed germinated.

Hybrid No. 56a: Ulka (No. 81) × Velvet Chaff (No. 130). Originated in 1916.

Description of parents: Ulka (No. 81), see Hybrid No. 54a. Velvet Chaff (No. 130), beardless; heads, large; straw, stiff; kernels, large; glumes, light colored and pubescent.

Description of hybrids: Too late. Discarded.

Hybrids Nos. 62a–t: Khogot (133) × Marquis (No. 131). Originated in 1917.

Description of parents: Khogot (No. 133), see Hybrids Nos. 30a–p. Marquis (No. 131), see Hybrids Nos. 30a–p.

Description of hybrids: Progeny not as promising as offspring of No. 30a, due no doubt to slight difference in the strain of the parents. The same variations were noted and selections were made accordingly. The time of ripening is the same for both sets of hybrids. Yields from small plats (1/660 acre) were at the rate of 34.3 bushels per acre. The average yield from four plats was at 25 bushels per acre.

Hybrid No. 63a-1: Khogot (No. 133) × Romanow (No. 127). Originated in 1917.

Description of parents: Khogot (No. 133), see Hybrids Nos. 29a–v. Romanow (No. 127), see Hybrid No. 24a.

Description of hybrids: This series offered less from which to choose than did either the Nos. 30 or 62 series. Both parents are bearded; consequently, all offspring are bearded. The larger type of head selected resembles the pistillate parent, but is somewhat earlier. In 1923 eight small plats (8/660 acre) yielded at the rate of 24.3 bushels per acre.

Hybrids Nos. 64a–q: Khogot (No. 133) × Ladoga (No. 126). Originated in 1917.

Description of parents: Khogot (No. 133), see Hybrids Nos. 29a–v. Ladoga (No. 126), see Hybrid No. 24a.

Description of hybrids: Since Ladoga and Romanow are almost identical in appearance and the staminate parent is common to both, it is to be expected that the hybrids of the Nos. 63 and 64 series should be alike. There are two general types, one small like Khogot, and the other large like Ladoga. The smaller type had rather open glumes with a tendency to shatter. The larger type is earlier than Ladoga and has large and handsome heads and stiff straw which will stand moderately rich ground. Two small plats yielded in 1923 at the rate of 24.7 bushels per acre.

Hybrids Nos. 100a–d: Hybrid No. 30a–8 × Red Bobs (No. 449). Originated in 1922.

Description of parents: Hybrid No. 30a–8, terminal bearded; glumes, light colored; kernels, angular, medium sized, and amber colored; straw, stiff; early. Red Bobs (No. 449), beardless; glumes, light colored; straw, stiff; kernels, short, plump, hard; not as early as series No. 30a.

Description of hybrids: The perjugate generation has handsome heads about 5 per cent of which are bearded. The others are beardless or terminal bearded. Heads, large, well filled; ripe August 19. None of 42 heads bred true, although planted in separate rows. Further selections will be made. Some of these hybrids should prove desirable sorts for northern latitudes.

Hybrids Nos. 101a–b: Ruby (No. 392) × Red Bobs (No. 449). Originated in 1923.

Description of parents: Ruby (No. 392), bearded, with open heads; glumes, light colored; kernels, medium sized, and amber colored; straw, stiff; early. Red Bobs (No. 449), see Hybrids Nos. 100a–d.

Description of hybrids: Six seeds resulted from this cross, five of which grew and produced plants. All heads were beardless, of fair size, and well filled.

Hybrid No. 69a: Beta (No. 412) × Hybrid No. 62a. Originated in 1919.

Description of parents: Beta (No. 412), bearded; glumes, light colored; kernels, amber colored; small; straw, medium length and stiff. Hybrid No. 62a, beardless; glumes, dark; kernels, amber colored and medium sized; heads, medium sized; early.

Description of hybrids: No seed ripened. Discarded.

Hybrid No. 70a: Beta (No. 412) × Hybrid No. 62a. Originated in 1919.

Description of parents: Beta (No. 412), see Hybrid No. 69a. Hybrid No. 62a, see Hybrid No. 69a.

Description of hybrids: No seed ripened. Discarded.

Hybrids Nos. 72a–c: Hybrid No. 62a × Khogot (No. 133). Originated in 1919.

Description of parents: Hybrid No. 62a, see Hybrid No. 69a. Khogot (No. 133), see Hybrids Nos. 29a–v.

Description of hybrids: No seed ripened. Discarded.

Hybrids Nos. 73a–h: Beta (No. 412) × Hybrid No. 63a. Originated in 1919.

Description of parents: Beta (No. 412), see Hybrid No. 69a. Hybrid No. 63a, beardless; glumes, dark; kernels, medium sized; straw, stiff; early.

Description of hybrids: No seed ripened. Discontinued.

WINTER WHEAT HYBRIDS

Hybrids Nos. 60a–d: Andrischinskaya (Sta. No. 312; Russian No. 804) × Kharkof (S. P. I. No. 12001). Originated in 1916.

Description of parents: Andrischinskaya, short terminal beards; straw, stiff; partially winter hardy; medium early. Kharkof (S. P. I. No. 12001), bearded; straw, medium stiff; more winter resistant than Andrischinskaya; early.

Description of hybrids: Not winter hardy.

Hybrid No. 62a–1: Andrischinskaya × Sandomirka (No. 203). Originated in 1916.

Description of parents: Andrischinskaya. See Hybrids Nos. 60a–d. Sandomirka (No. 203), terminal bearded; heads, long and tapering; glumes, copper colored.

Description of hybrids: Not winter hardy.

Hybrids Nos. 59a–n: Sandomirka (No. 203) × Kharkof (S. P. I. No. 12001). Originated in 1916.

Description of parents: Sandomirka (No. 203), see Hybrid No. 62a–1. Kharkof (S. P. I. No. 12001), see Hybrids Nos. 60a–d.

Description of hybrids: Not winter hardy.

Hybrids Nos. 45a–e: Kharkof (S. P. I. No. 12001) × Sandomirka (No. 203). Originated in 1916.

Description of parents: Kharkof (S. P. I. No. 12001), see Hybrids Nos. 60a–d. Sandomirka (No. 203), see Hybrid No. 62a–1.

Description of hybrids: Not winter hardy.

Hybrids Nos. 61a–c: Sandomirka (No. 203) × Andrischinskaya. Originated in 1916.

Description of parents: Sandomirka (No. 203), see Hybrid No. 62a–1. Andrischinskaya, see Hybrids Nos. 60a–n.

Description of hybrids: Not winter hardy.

WINTER RYE HYBRIDS

Hybrid No. 37a–1: North Dakota (G. I. No. 659) × Giant French (No. 199). Originated in 1915.

Description of parents: North Dakota (G. I. No. 659), hardy; heads, slender; early. Giant French (No. 199), hardy; heads, broad; early.

Description of hybrids: Excessively sterile heads. Discontinued.

Hybrid No. 39a–1: Giant French (No. 199) × Amber (No. 194). Originated in 1915.

Description of parents: Giant French (No. 199), see hybrid No. 37a–1. Amber (No. 194) hardy; heads, long, medium large; medium early.

Description of hybrids: Partly sterile; no improvement over parents. Discontinued.

Hybrids Nos. 47a–o: G. I. No. 281 × Russian No. 73. Originated in 1917.

Description of parents: G. I. No. 281, hardy; heads, slender and small; early. Russian No. 73, hardy; heads, slender; early.

Description of hybrids: No improvement over parents. Discontinued.

Hybrids Nos. 48a–g: Russian No. 322 × Russian No. 63. Originated in 1917.

Description of parents: Russian No. 322, hardy; heads, slender; early. Russian No. 63, hardy; heads, slender; early.

Description of hybrids: No improvement over parents. Discontinued.

SPRING RYE HYBRIDS

Hybrids Nos. 34a–f: Mammoth (No. 125) × Irkutsk (No. 132). Originated in 1914.

Description of parents: Mammoth (No. 125), heads, large; kernels, medium size; late. Irkutsk (No. 132), heads, slender, better filled than any other spring rye; medium early.

Description of hybrids: No improvement over parents. Sterile, late, and unsatisfactory.

Hybrid No. 42a: Gesselberg (No. 80) × Irkutsk (No. 132). Originated in 1915.

Description of parents: Gesselberg (No. 80), heads, slender, imperfect; medium early. Irkutsk (No. 132), see Hybrids Nos. 34a–f.

Description of hybrids: Discontinued. No improvement over parent; sterile; late.

Hybrids Nos. 43a–b: Gesselberg (No. 80) × Hybrid No. 34e. Originated in 1915.

Description of parents: Gesselberg (No. 80), see Hybrid No. 42a. Hybrid No. 34e, slender heads, well filled; medium early.

Description of hybrids: Discontinued: No improvement over parents; sterile; late.

Hybrids Nos. 50a–f: Irkutsk (No. 132) × Gesselberg (No. 80). Originated in 1916.

Description of parents: Irkutsk (No. 132), see Hybrids Nos. 34a–f. Gesselberg (No. 80), see Hybrid No. 42a.

Description of hybrids: Discontinued; no improvement over parents; sterile; late.

SUMMARY

Southeastern Alaska, taken as a whole, is not suited to grain growing because heavy precipitation in late summer and fall renders it difficult to harvest the crops in good condition, and there are no extensive areas which can be cleared and cultivated at a moderate cost. There are some exceptions, as for instance at Haines, where grain can be grown on a small scale. The climate and soil of this region are, however, well adapted to grain growing for hay and silage, and will often produce heavy yields.

Grain for seed can not be grown on Kenai Peninsula, Kodiak Island, Alaska Peninsula, and the Aleutian Islands, but forage can be produced in abundance. These regions are especially suited to stock raising.

Only the very earliest varieties of grain will mature in the Copper River Valley. The first fall frost usually occurs about August 15, and grain that has not matured then must be cut for hay.

The Yukon, Tanana, and Matanuska Valleys have fully demonstrated their adaptability to grain growing, and it is probable that the Susitna and Kuskokwim Valleys also are suited for grain cultivation on a large scale, although as yet no experiments have been made there.

Early maturing varieties of barley, oats, and spring wheat are best suited to the climatic conditions of Alaska. Late varieties will mature only in very favorable seasons.

Winter rye can be successfully grown south of the Arctic Circle, but requires 13 months to mature. Seeding should take place about August 1, so that the crop will ripen about September 1 of the year following.

Many trials have been made with winter wheat, but so far no variety has been found hardy enough to withstand the winters. Wheat growing must be limited to spring varieties until a hardy winter wheat is found or developed.

The frost-free period in the Yukon and Tanana Valleys is about 97 days; sometimes it exceeds this length, and occasionally it is shortened by an unusually early frost. Early varieties can always be counted on to mature in the frost-free period. Records have not been kept long enough to state with certainty the length of the frost-free period in the Matanuska Valley, but it will exceed 100 days. In this connection it should be stated that the end of the frost-free period is determined by a fall of temperature to 32° F. or below; and since exposure for a short time to 2° or 3° of frost does not injure growing grain except in the blossoming season, the period in which grain is safe will be longer than is indicated above.

The almost continuous daylight in the Yukon and Tanana Valleys during June and July hastens the growth of the grain, so that crops will mature as early as the same varieties in the Matanuska Valley, 3 degrees farther south.

Siberian No. 1, a variety of spring wheat which was obtained originally from Russia, is the earliest wheat so far discovered. It is dwarf in habit, however, and should be supplanted by a more vigorous variety which is equally early. Hybrids, obtained by crossing Siberian No. 1 with vigorous varieties, are expected to be better yielders than the Siberian parent and almost as early.

Hybridization work has developed some very desirable varieties of barley and oats, which are expected to supplant the varieties now being grown.

Fall plowing and early spring seeding are two cardinal principles in grain growing in Alaska.

Soil fertility should be conserved by a judicious rotation of crops and the growing of legumes for green manure. Peas and vetches have done well at the stations, and proved their value as soil renovators.

Alaska imported from the States in 1924 $650,000 worth of cereals and cereal products capable of being produced in the Territory, paying prices which indicate good market possibilities for the home-grown products. The problem is one of distribution rather than market.

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